A CONTINUUM DAMAGE MODEL FOR BOLTED JOINT FAILURE PREDICTION IN FIBER-REINFORCED COMPOSITES

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Abstract: The present study presents a three-dimensional Continuum Damage Model (CDM) applied to failure prediction of composite bolted joints, implemented into Abaqus™/Explicit Finite Element (FE) code using a VUMAT user-subroutine. The damage model is developed on an energy-based context, enabling the prediction of failure initiation and propagation at the intralaminar level. The model is capable of predicting longitudinal, transverse and in-plane shear failure modes. Mesh independence is achieved through a damage evolution rule that accounts for the damage progression speed. Interlaminar failure mechanisms are also implemented in the model utilizing Cohesive Elements (CEs), natively available in Abaqus™. The prediction of variable mixed-mode failures is possible without the need of prior knowledge concerning the mixity ratio between delamination modes. This is achieved through the application of a single-damage variable for all delamination modes. Numerical predictions of the load-displacement behavior, as well as damage propagation and failure of single-lap bolted joints are presented and assessed through a correlative study with experimental and numerical results available in literature.

Keywords: Continuum Damage Mechanics, Explicit Finite Element Analysis, Fiber-Reinforce Composites, Bolted Joints.